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Water Quality Index of Groundwater in Nine Tribal Block of Madhya Pradesh

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ABSTRACT

This study aimed that assessing the water quality index of groundwater in nine tribal blocks of Madhya Pradesh. It has been determined by collecting 77 groundwater samples and subjecting the samples to a physicochemical analysis. For calculating the water quality index, the following 18 quality parameters have been considered: pH, EC, carbonate, bicarbonate, calcium, magnesium, chloride, sodium, potassium, phosphorus, nitrate, chromium, nickel, cadmium, lead, copper, iron and zinc. The result shows the water quality index of these 77 samples obtained from 22.41 to 200.59. The analysis reveals that the groundwater of the area needs some degree of treatment before consumption, and it also needs to protect from the pollutions.

Key words: *Groundwater, Water quality parameters, Water quality index.*

INTRODUCTION

Groundwater is used for domestic and industrial water supply and irrigation all over the world. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization. Human health is threatened by most of the agricultural development activities particularly in relation to excessive application of fertilizers and unsanitary conditions. Rapid urbanization, especially in developing countries like India, has affected the availability and quality of groundwater due to its overexploitation and improper waste disposal, especially in urban areas. Water Quality Index is valuable and unique rating to depict the overall water quality status in a single term that is helpful for the selection of appropriate treatment technique to meet the concerned issues[14].Water quality indices is tools to determine conditions of water quality. Creating the Water Quality Index involves three main steps[15]. (1) obtain measurements on individual water quality indicators (2) transform measurements into ‘‘sub index’’ values to represent them on a common scale (3) aggregate the individual sub index values into an overall Water Quality Index value.

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MATERIAL AND METHODS

In order to achieve the objectives of the study, Groundwater collected from selected tribal districts of Madhya Pradesh was used for analysis.

Location of study area: Collection was made from nine blocks such as - Kundam, Bajag & Karanjia, Mohgaon & Bichhia, Chhappra, Kurai, Keolari & Ghansore from districts of Madhya Pradesh- Jabalpur, Dindori, Mandla and Seoni. Composite sample was stored in non-reactive plastic bottles. Plastic bottles of 1 liter capacity with stopper were used for collecting samples. Each bottle was washed with 2% Nitric acid and then rinsed three times with distilled water. The bottles were then preserved in a clean place. The bottles were filled leaving no air space, and then the bottle was sealed to prevent any leakage. Each container was clearly marked with the name and date of sampling. Groundwater samples were collected between 8 am to 11.00 am. Open well samples were collected in seventy seven different location shows in fig 3.1.

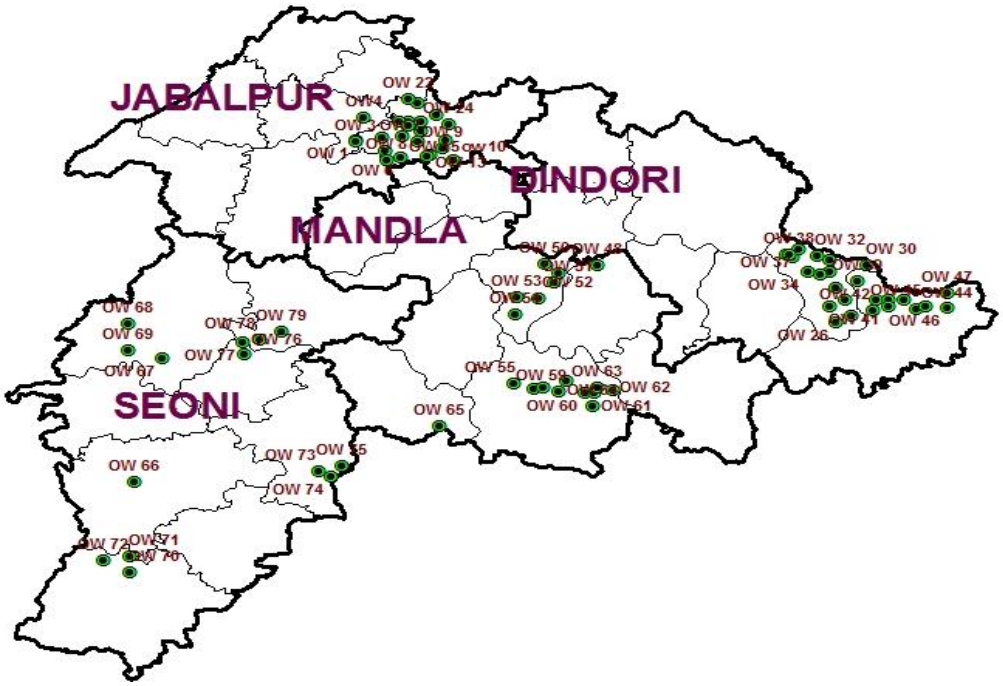

Fig. 1: Location of ground water sampling

Water Quality Index

The main objective of Water Quality Index is to turn complex water quality data into information that is understandable and useable by others. Water Quality Index based on some very important parameter can provide a simple indicator of water quality. It gives the public a general idea of the possible problems with water in a particular region. The indices are among the most effective ways to communicate the information on water quality trends to the policy makers and water quality management, personals.

For computing WQI three steps are followed.

1. In the first step, each of the 18 parameters has been assigned a weight (w_i) according to its relative importance in the overall quality of water for irrigation purposes (Table 3.3). A weight age range 1 to 5 is provided with value 5 to the most favorable one and also assigning value 5 to the unlike (dangerous). Obviously, for the parameter whose presence is neither beneficial nor harmful will carry a weight age of 1.

2. In the second step, the relative weight (W_i) is computed from the following equation:
3.

$$Wi = \frac{w_i}{\sum_{i=1}^{n} W_i} \quad (1)$$

Where,

W_i = relative weight,

w_i = weight age of each parameter

4. In the third step, a quality rating scale (qi**)** for each parameter is assigned by dividing its concentration in each water sample by its respective standard according to the guidelines laid down in the BIS and the result multiplied by 100 :

$$qi = (Ci / Si) \times 100 \quad (2)$$

Where,

qi = quality rating

Ci = Concentration of each chemical parameter in each water sample in mg/l

Si = Standard for each chemical parameter in mg/l

5. For computing the water quality index, the SI is first determining for each chemical parameter.

$SI_i = Wi \times q_i$

$WQI = \Sigma SI_i$

Where,

SI_i = Subindex i^{th} parameter

q_i = rating based on concentration of i^{th} parameter

Table 1: Relative weight of chemical parameters

Chemical parameter	Irrigation water quality standard	Weight	Relative Weight
pH	6.5-8.5	5	0.12
EC	300	4	0.09
CO_3	600	2	0.05
HCO_3	600	2	0.05
Cl	1100	2	0.05
Ca+Mg	600	2	0.05
Na	90	4	0.09
K	20	2	0.05
P	36	1	0.02
NO_3	45	3	0.07
Cr	0.1	1	0.02
Ni	5.0	1	0.02
Cd	0.01	5	0.12
Ld	2.0	5	0.12
Cu	0.2	1	0.02
Fe	5.0	1	0.02
Zn	10	1	0.02
Mn	0.2	1	0.02
		Σ wi = 43	Σ Wi = 1

Ground water samples were categorized as per WQI given by Ramkrishnaiah *et al*.[11], The limits of categories are given in table 3.2

Table 2: Water quality at Scale-100

Excellent	< 50
Good	50-100
Poor water	100-200
Very poor water	200-300
Water unsuitable for drinking and irrigation	>300

RESULT

Table 3.3 shows the WQI as obtained from ground water samples of different villages under different blocks. It is observed that in Kundam block 79.1% (19 villages) samples fall under excellent categories and 20% (5 villages) samples fall in good categories. WQI observed excellent water quality 66 % (4 villages) and 90 % (9 villages) and good quality water 33 % (2 villages) and 10 % (1 village) in ground water sample obtained from Mohgaon and Bichhia blocks respectively. In chhappra, Kurai and Gahansore blocks show only 50% (2 villages), 66% (2 villages) and 25% (1 village) of water samples fall in excellent categories of water quality and rest of the samples in these blocks was found in good category but in Keolari block 66% (2 village) ground water sample was found of poor quality water. In Bajag and Karanjia blocks water samples was found in excellent categories 57% (8 villages) and 66.6% (6 villages) respectively, rest of ground water in these blocks fall under good quality of water.

Table 3: Water Quality Index

Kundam Block			
Name of Village	**WQI**	**Name of Village**	**WQI**
Amera	31.43	Hinota	33.40
Amjhar	56.39	Imlai raja	57.88
Amjhar	39.08	Jamunia	33.49
Baghraji	55.20	Karanpur	22.46
Baghraji	56.64	Khamaria	37.79
Bargaon	30.85	Khargaon	25.76
Barkheda	45.89	Kundam	43.08
Batai	29.63	Kundwara	51.62
Bichuwa	22.41	Mehgawan	38.96
Deorikala	26.42	Rauriya	32.91
Dunda	26.26	Tilsani	26.29
Dhanwahi	32.99	Touri	29.33
Karanjia Block			
Name of Village	**WQI**	**Name of Village**	**WQI**
Bajag	54.91	Kaudia	39.55
Bijhauri	44.99	Lalpur	50.69
Bondar	32.40	Majhiyakhar	40.29
Dhanoli	55.72	Rampurikala	53.00
Gadasarai	33.42	Singhpur	68.43
Harratola	48.51	Sukulpura	67.02
Karopanitola	33.82	Vikrampur	37.32
Bajag Block			
Name of Village	**WQI**	**Name of Village**	**WQI**
Barbaspur	53.41	Mohtara	50.36
Gorakhpur	44.63	Ramnagar	46.23
Harratola	43.07	Rusarait	43.90
Karanjia	60.25	Sunpuri	33.13
Manikpur	44.023		
Bichhia Block			
Name of Village	**WQI**	**Name of Village**	**WQI**
Anjania	34.98	Koko	45.14

Bichhia	42.20	Majhipur	39.65
Dongra	46.60	Medhatal	48.42
Gubri	44.64	Orai	59.16
Kannharikalan	35.41	Tikaria	46.38
Mohgaon Block			
Name of Village	**WQI**	**Name of Village**	**WQI**
Andia	39.56	Khisi	38.17
Deogaon	33.05	Saliwara	54.98
Indramal	38.92		
Chhappra Block		**Ghansore Block**	
Name of Village	**WQI**	Balpur	**WQI**
Baghraj	47.72	Kahani	79.77
Gopalganj	32.57	Mehta	80.27
Lakhnadon	52.76	Salema	49.85
Sonadongri	74.61	Salema	59.82
Kurai Block		**Keolari Block**	
Name of Village	**WQI**	Khairi	**WQI**
Bamhani	38.92	Malari	110.56
Chargaon	79.68	Sarekha	96.75
Mohgaon	46.75	Sarekha	200.59

Blocks	**Total Villages**	**Excellent Villages**	**% of Total Villages**	**Good Villages**	**% of Total villages**
Kundam	24	19	79.1	5	20.9
Karanjia	14	8	57.1	6	42.9
Bajag	9	6	66.7	3	33.3
Bichhia	10	9	90	1	10
Mohgaon	6	2	33.3	4	66.7
Chhappara	4	2	50	2	50
Ghansore	4	1	25	3	75
Kurai	3	2	66.7	1	33.3
Keolari	3	1	33.3	2	Poor quality

CONCLUSION

In this study, 18 parameters were found within desirable limit. According to water quality index all 76 ground water sample of these blocks fall in excellent category, only one ground water sample of blocks fall under poor quality category, which was found 200.59.

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